This summarizes Black & Veatch responses to the Utility Service Board (USB) questions and public comments received at the April 14, 2008 USB meeting. The questions and comments concern the proposed expansion of the Monroe Water Treatment Plant (WTP) as presented in the 2003 Long Range Water Capital Plan (LRWCP) and 2007 Water Supply Evaluation (WSE) reports. The specific questions are summarized and responses are indicated below:

Comment

1. What is the cost of the west leg distribution system improvements that will be performed under a separate contract by the City of Bloomington Utilities (CBU)?

- The estimated opinion of probable project cost, including the construction, professional services and easement acquisition, for the west leg improvements is $4 million. The 24-inch West branch main is required to reinforce the western portion of the Central Zone and will be completed by CBU as a separate project. The West branch includes a 24-inch water main from Sare Road west along Rhorer Road, then north along South Rogers Street to West Country Club Drive, then west along County Club Drive to connect to two existing 24-inch mains at the intersection of Rockport and West Tapp Roads.

Comment

2. What would be the cost to increase capacity of the Monroe WTP by 6 million gallons (MG) in the future if expanded to 30 million gallons per day (mgd) now?

- The estimated cost for the expansion of the Monroe WTP in a second 6 mgd increment from 30 to 36 mgd would be more than just the difference between the two alternatives of expanding the Plant to 30 mgd or 36 mgd initially. There are costs associated with performing the project in phases including additional contractor mobilization, demobilization and supervision. In addition, the cost of professional services would be greater to perform the project in two phases. The estimated increase is typically 10 to 15 percent greater than performing the work in one phase. Therefore, the opinion of probable project cost to expand from 30 mgd to 36 mgd would be approximately $6.7 million based on January 2007 price levels compared to $5.8 million difference if performed as one larger project.
- It is estimated that the expansion to 36 mgd will be required in 2025. Assuming inflation at 3% per year, the cost in 2025 when additional capacity is projected to be required would be $11.4 million.

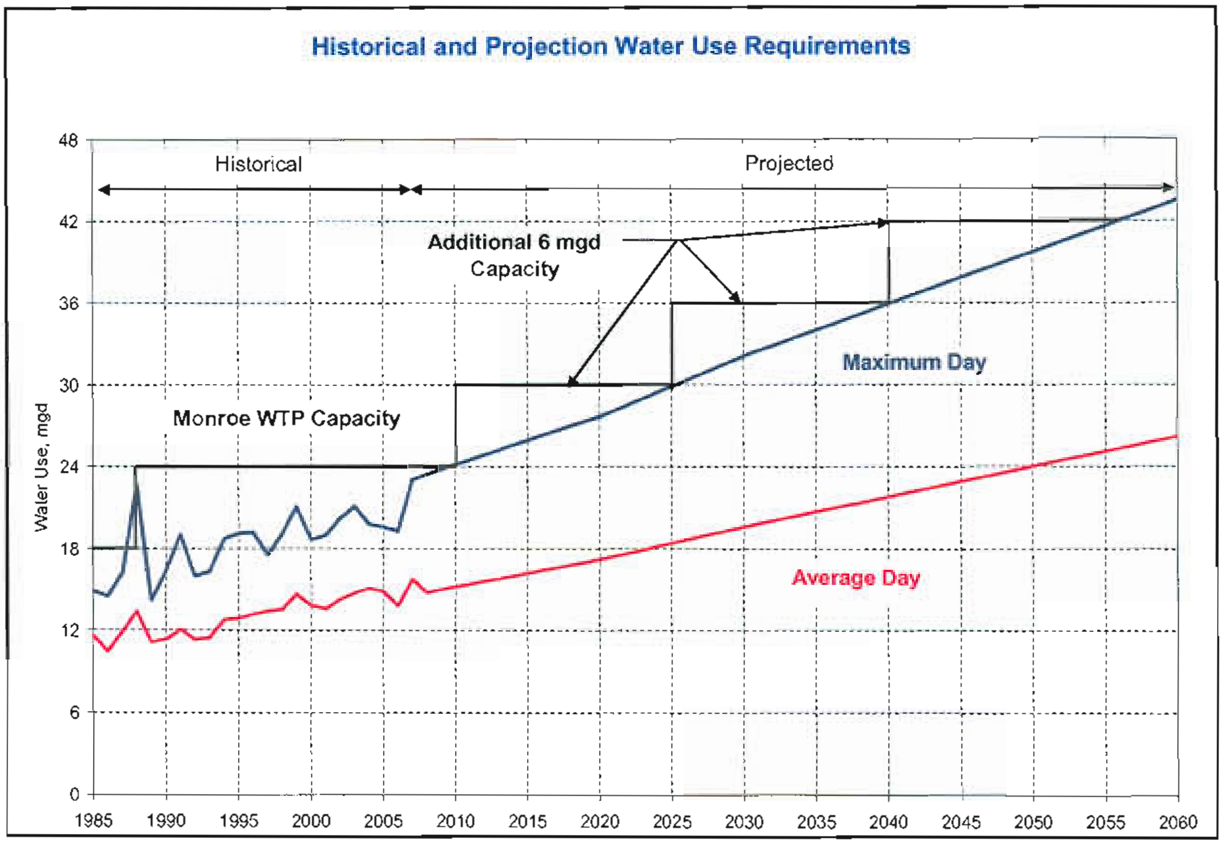
Comment
3. How were the water demand projections and graphs in the Water Supply Evaluation developed?

- As part of the WSE in Section 2, Black & Veatch (B&V) re-examined the original population projections developed in Section 2 of the LRWCP. Based on population projection comparison between Indiana STATS, B&V and the 2030 Long Range Transportation Plan (LRTP) prepared by the Metropolitan Planning Organization Staff of the City of Bloomington Planning Department, it was recommended in the WSE to continue the use of the B&V projections as the projections are aligned with Indiana STATS and the LRTP.
- As indicated in Sections 3 of the LRWCP and the WSE, population projections and historical water use are the most common means for projecting water demands. In Section 3.B of the LRWCP, the water use projections were determined to 2030 through 10-year increments. Based on the LRWCP and WSE population projections, the water use projections were extrapolated to 2060 through 10-year increments. The analysis of the water requirements utilizing the population projections results in a projection of the residential water use requirements for the CBU.
- Based on the recommendation regarding the population projections and the minimal effect on residential water use projections for varying population projections, the water use projections developed by B&V for the LRWCP were utilized to project water use requirements. Table 3-3 and Figure 3-1 from the WSE list the projected water use requirements. These water use projections include residential, wholesale, industrial-commercial-institutional (ICI), Indiana University and unaccounted-for water demands. The historical demands for years 2001-2007 have been included in the evaluation. The figure indicates the projected timing of treatment capacity expansion in 6 mgd increments.

Table 3-3
Projected Water Use Requirements per B&V LRWCP Population Projections

Year	Average Day, mgd	Maximum Day, mgd	Maximum Hour, mgd
2000	13.1	20.6	24.5
2010	15.2	24.2	28.7
2020	17.2	27.7	32.9
2030	19.6	32.2	38.1
2040[1]	21.8	35.9	42.6
2050[1]	24.0	39.7	47.1
2060[1]	26.2	43.5	51.6

[1] Values for 2040, 2050 and 2060 are extrapolated from the projected values (2010, 2020 and 2030) developed with the Long Range Water Capital Plan (January 2003).



- In Section 3.B of the LRWCP, historical water use and population projections were used to estimate the average water use on a per capita basis for residential customers for the base year 2000 and years 2010, 2020 and 2030. The AD residential water use was determined by multiplying the per capita water use of 85 gallons per day by the population. The AD ICI, Indiana University, wholesale, and unaccounted-for water use was estimated on a proportional basis. Per the LRWCP, the design criteria used for calculating the AD water requirements are summarized in Table 3-4.

Table 3-4 Design Criteria for Average Day Water Use Calculations				
Design Criteria	**2000**	**2010**	**2020**	**2030**
Population [a]	53,154	64,187	77,506	93,023
Base Residential Use [b]	85 gpcd	85 gpcd	85 gpcd	85 gpcd
Residential/ICI Ratio (%)	38/62	40/60	42/58	44/56
Unaccounted - for (%)[c]	10	10	10	10
MD/AD Ratio	1.60	1.60	1.60	1.60
MH/AD Ratio	1.90	1.90	1.90	1.90

a. The population shown is the residential population less IU on-campus housing occupants.
b. The base residential use was determined by dividing the total residential water use of 4.5 mgd by 53,154 people (year 2000 population of 69,291 less IU on-campus housing population of 16,137).
c. For design, it is typical to allow 10% for the unaccounted-for water. Even though CBU averages 6.5% unaccounted-for water, 10% was used for design calculations.

- Per the LRWCP, the AD water use by class is summarized in Table 3-5.

Table 3-5 Base Year and Projected Average Day Water Use by Class								
User Class	**2000**		**2010**		**2020**		**2030**	
	mgd	**%**	**mgd**	**%**	**mgd**	**%**	**mgd**	**%**
Residential	4.5	34	5.5	36	6.6	38	7.9	40
ICI	2.7	20	3.5	22	4.0	23	4.7	24
IU	1.8	14	1.8	12	1.8	10	1.8	9
Wholesale	2.9	22	3.0	20	3.2	19	3.4	17
Subtotal	**11.9**	**90**	**13.8**	**90**	**15.6**	**90**	**17.8**	**90**
Unaccounted-for	1.2	10	1.4	10	1.6	10	1.8	10
Total	**13.1**	**100**	**15.2**	**100**	**17.2**	**100**	**19.6**	**100**

- The maximum day water use was determined by applying the MD/AD peaking factor of 1.60 to the average day water use. Although the peaking factor typically is used system-wide (i.e. assigning the same factor to each user class) to project future water requirements for design, assigning each user class its own factor was more appropriate. This is mainly due to the affect of residential water use on the distribution system as compared to other user classes. The peaking factor for residential use is typically higher than the overall average and those for ICI, IU, wholesale, and unaccounted-for use are usually lower. Residential water use has a greater influence on the distribution system than any other user because of variations in use. Residential areas typically have greater water usage due to watering the lawn, washing cars, and recreational uses. Industrial areas have flow patterns that repeat as manufacturing begins and ends each weekday. Also, it is anticipated that ICI, IU, wholesale, and unaccounted-for water will have limited growth as indicated in Table 3-5 above.

Comment
4. How common is it to pump more than the treatment capacity?

- In Section 3.A. of the LRWCP, historic water use data including average day (AD), maximum day (MD) and maximum hour (MH) water demands were analyzed. A risk analysis was performed to determine the appropriate return rate desired for peaking factor development for maximum day and maximum hour demands. Frequency distribution plots were prepared using the historic water use data and are shown in Figures 3-3 and 3-4 in the LRWCP and are enclosed as an attachment to this letter. The figures show the percent probability of a peaking factor being exceeded, based on historical data. The figures also show the design peaking factors of 1.60 for MD/AD and 1.90 for MH/AD. The selected MD/AD factor of 1.60 represents a return period of 9 years. Statistically, based on a 9-year return period, the risk of being exceeded in any year would be approximately 11%. The MH/AD factor represents a return period of 20 years and statically the risk of being exceeded in any year would be 5%. It was determined that this was a reasonable level of risk and is consistent with the level of risk used for other utilities.
- It is not standard practice to pump more flow to the distribution system than the treatment facility can treat. This practice poses risks on meeting customer demands and therefore is not recommended.

Comment
5. At what level does the Indiana Department of Environmental Management (IDEM) want a utility to expand capacity? CBU has 24 mgd capacity, how comfortable should CBU be at treating 24 mgd for 6, 12 or 18 hours per day?

- IDEM stipulates that a public water system's highest daily pumpage as reported over the previous 2 year period not exceed 90 percent of the system's capacity: this would be compared to the plant capacity with one filter out of service. For CBU, 90 percent of the 18 mgd capacity (filter capacity with one filter out of service) is 16.2 mgd.

Comment
6. What facilities and equipment would be required to increase capacity at the Plant from 30 mgd to 36 mgd in the future? Also, what facilities could be constructed with equipment installed now to treat 30 mgd with additional equipment needed to increase capacity to 36 mgd in the future?

- To increase capacity from 30 mgd to 36 mgd, the intake facility pumps would require replacement with larger pumps; the Filter Building expansion with additional filters, piping, valves, etc. would be added; the High Service Pump Station would be expanded and additional pumps installed; the Transfer Pump Station would require additional pumps; and sitework would be required. Some of the older chemical feed systems not replaced as part of the Monroe WTP Improvements would need to be further evaluated to ensure storage and sizing for 36 mgd.

- To construct all facilities now for the future treatment capacity of 36 mgd would include additional filters, high service pump station and sitework. It is estimated that the construction cost for the filter boxes and filter building space as well as the high service pump station building needed for 36 mgd would be approximately $3.1 million more than the cost to construct facilities for 30 mgd. Note the filters required to treat 36 mgd would not include media, piping, valves, underdrains, etc. The high pumping capacity would only be installed to convey and treat 30 mgd initially.

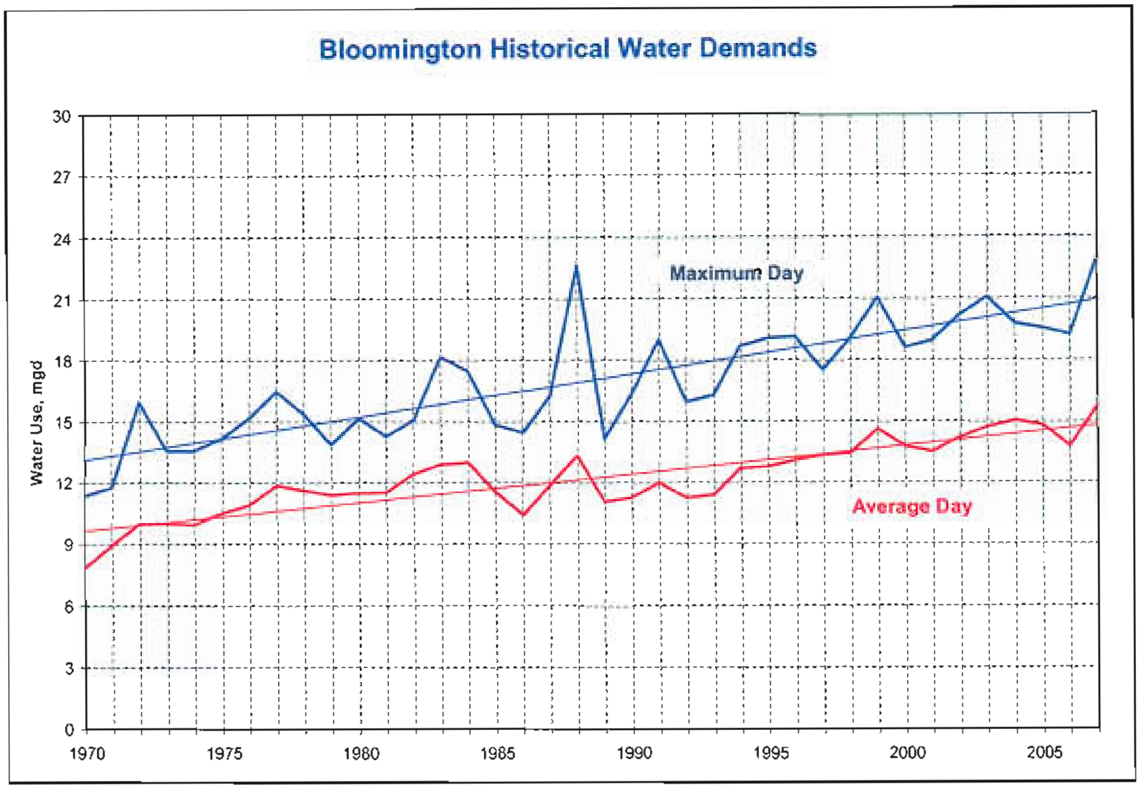
Comment
7. Discussion on Maximum Day. Reference was made to the City of Bloomington's Environmental Commission Report which indicates that water usage has leveled off. Also comments indicated the population trends, and therefore per capita use, have also leveled off.

- As indicated above, in Section 2 of the WSE B&V re-examined the original population projections developed in the LRWCP. Further, B&V again investigated actual population estimates as documented by the US Census Bureau and Indiana STATS in April 2008 to verify the previous projections remain accurate. The following table indicates the historic published population estimates for Monroe County from each entity:

Population Estimates	2000 Census*	2001	2002	2003	2004	2005	2006	2007
US Census Bureau	120,563	121,406	121,722	123,166	124,385	125,428	127,306	128,643
IN STATS	120,563	121,419	121,743	123,194	124,423	125,453	127,367	128,704

*2000 Census - Indicates 2000 US Census Data
Population Estimates obtained at http://www.census.gov/popest/counties/tables/CO-EST2007-01-18.xls and http://www.stats.indiana.edu/population/popTotals/2007_cntyest.html, respectively.

- Both the US Census Bureau and Indiana STATS data indicate that Monroe County growth has not leveled off but rather has continued to grow at about 1 percent per year from 2000 to 2007. Based on population projection comparison between Indiana STATS, B&V and the 2030 Long Range Transportation Plan (LRTP) prepared by the Metropolitan Planning Organization Staff of the City of Bloomington Planning Department, it was recommended in the WSE to continue the use of the B&V projections as the projections are aligned with Indiana STATS and the LRTP.
- At the August 27, 2007 USB meeting, B&V presented the below figure which indicates the 1970 to 2007 historical treated water day demands at the Monroe WTP. The figure indicates that maximum day and average day demand trends have continued to increase.



- We have reviewed the City of Bloomington's Environmental Commission Report from their website and have the following comments in regards to the report:
  - Figure 1b, "Total Bloomington Water Consumption" indicates strictly the average day usage and not the maximum day usage. As discussed in the LRWCP and WSE and presented at previous USB meetings, maximum day demands are used for sizing water treatment facilities. Average day demands are used for determining revenue, chemical usage and water supply yield.
  - It should be noted that Figure 1b, "Total Bloomington Water Consumption" appears to not contain unaccounted for water as it references Table 3-3 in the LRWCP. Unaccounted for water was estimated at 10% for the LRWCP for average day water use calculation; therefore, the average day use in Figure 1b does not reflect all water that the Monroe WTP produces.
  - Although we have not performed an analysis of all metered water use as was performed for Section 3 of the LRWCP, we have reviewed the Monroe WTP finished water pumping rates for the same time period, 1990 to 2007, as was performed in the Environmental Commission Report to update Table 3-6 in the LRWCP. The following table indicates the Monroe WTP high service pumping rates for years 1990 to 2007.

Year	Monroe WTP High Service Pumping Total , MG	Monroe WTP Service Pumping Daily Average, MGD
1990	4,318	11.83
1991	4,278	11.72
1992	4,275	11.68
1993	4,493	12.31
1994	4,756	13.03
1995	4,391	12.03
1996	4,619	12.62
1997	4,730	12.96
1998	4,738	12.98
1999	5,055	13.85
2000	4,827	13.19
2001	4,778	13.09
2002	5,018	13.75
2003	4,864	13.33
2004	4,941	13.50
2005	4,769	13.07
2006	4,606	12.62
2007	5,147	14.10

- The above table and trends also indicate that overall water usage has continued to increase, not decrease as reported in the Environmental Commission Report.

Comment
8. Discussion on Maximum Day. Questions were raised at the April 14, 2008 USB meeting about evaluating the average 3 or 5 day average maximum day demand, in lieu of just the single maximum day demand.

- B&V requested the city/utility name where it was suggested 3 or 5 day average maximum day demands were being used to size water treatment facilities. B&V contacted Mr. Gary Kent on April 22, 2008 to obtain this information. Mr. Kent indicated the utility was in Oregon and he was unsure if they actually implemented this approach, but rather they evaluated it. It is B&V's recommendation that CBU continue to design water supply and treatment facilities based on maximum day demand in accordance with industry standards.

9. Discussion on rated capacity of the filters. Questions were raised regarding if the State of Indiana imposes overly conservative filtration loading rates and if the existing filters at the Monroe WTP can be modified to increase the filtration loading rate and thereby increase the capacity of the Plant.

- The 10 States Standards, Part 4.2.1.3 stipulates that filters shall be capable of meeting the plant design capacity [maximum daily demand] at the approved filtration rate with one filter removed from service. The Indiana Department of Environmental

Management (IDEM) requires the filters to be sized for a maximum loading rate of 4 gallons per minutes per square foot (gpm/sf) with one filter out of service. At 4 gpm/sf and one filter out of service, the Monroe WTP has a capacity of 18 mgd.

- Although the term "gravity" is used when describing the Monroe WTP filters, there are many components associated with filter operation, including piping, valves, flow meters, controls, electrical, etc. that require maintenance and are subject to failure. The 10 States Standards requirement is necessary to allow the plant to remove a filter from service in order to perform regular required backwashing (filter cleaning) and to maintain filters and any peripheral equipment that directly affects filter operation.
- B&V has previously investigated increasing the filter loading rate above 4 gpm/sf; however, going to a higher filtration rate is in excess to what IDEM permits. Also, while it is feasible through pilot studies to demonstrate performance at higher filtration rates, there are several issues that have been considered:
    - At higher filtration rates, hydraulics becomes an issue. Sufficient head may not be available to load the filters at this higher filtration rate due to the depths of the existing filter boxes. As was indicated at the USB April 14, 2008 meeting, the loading rate of the filters has already been increased in the past. Increasing it again, may not be hydraulically feasible.
    - Influent and effluent piping sizes become an issue. The velocities through these pipes become very high and well above 10 States Standards. Complete sections of piping and valves would require replacement.
    - With only four filters, the increase in the hydraulic loading for remaining in-service filters when a single filter is removed from service for backwashing is approximately 33 percent. At high design filter loading rates, this increase may be sufficient to cause problems in maintaining required filtered water turbidities. Most plants with filters operating at loading rates above 4 gpm/sf also employ more than 4 filters. This serves to reduce the potential detrimental impact on performance of in-service filters when a filter must be backwashed.
    - Alternative filter media configurations that will facilitate operation at higher hydraulic loading rates also typically require increases in both media depth and the depth of water maintained over the media surface in order to provide for acceptable filter run times between backwashes. Depths required to implement use of these alternative media configurations is not available in the existing filter boxes at the Monroe WTP.
    - Backwashing will have to be conducted more frequently as the filters become plugged with particles and headloss limitations are reached much quicker. Currently, there are times of the year when the raw water quality requires the plant to backwash each filter as often as once every 24-36 hours, which is much more frequently than desired in order to maintain high filter production efficiencies. At higher loading rates, filter runs would likely reduce to below 24 hours. Filter production efficiencies would be extremely low and this frequent filter backwashing becomes an operational concern.
    - Meeting turbidity requirements at a higher rate becomes more of an issue. The Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR or LT2) limits the turbidity to 0.3 NTU 95 percent of the time on the combined filter effluent. This requirement has historically been lowered over time and is anticipated that it could be again in the future. In order to maintain these low turbidity levels on a consistent basis, most plants have had to adopt more stringent filtered water turbidity goals (typically 0.1 NTU or lower) to ensure that

compliance with the 0.3 NTU requirement can be continuously achieved. The Monroe WTP has experienced problems meeting the current turbidity requirements in the past. Increasing the filter loading rate would likely cause additional problems.

- Also, it should be noted that adding additional filters is just one component of the overall plant expansion and accounts for approximately $4.2 million of the opinion of probable construction cost total of $15 million for the Monroe WTP Expansion.

Comment
10. Discussion on technology. The current water treatment plant was originally rated for 12 mgd. An appeal to the State and a change in filter media increased the rated capacity to 24 mgd. Are there other filter media that can provide a higher rated capacity? What technologies are available? What technologies might become available by the time we need additional capacity?

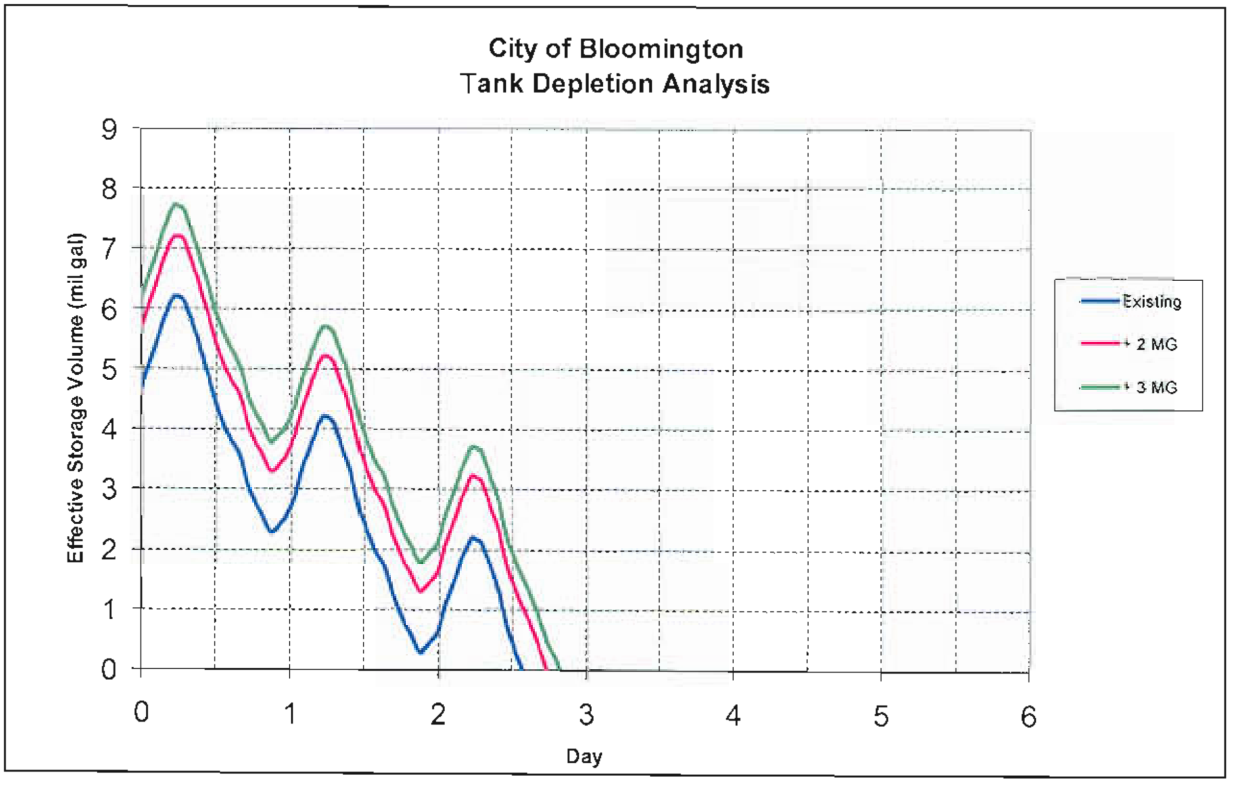
Response:

- The original plant was designed for 12 mgd. Modifications to the existing filters and additional high service pumping capacity enabled treatment of flows of up to 18 mgd. Following the completion of the 1986 Master Plan Report, CBU decided to expand the plant by adding tube settlers in the sedimentation basins to increase settling capacity which allowed the Plant to demonstrate treatment capacity of 24 mgd. CBU decided not to add an additional filter at this time and IDEM has questioned the rated plant treatment capacity in the past. The filter media for Filters 1 and 2 was replaced in 1990 while media in Filters 3 and 4 was replaced in 1979. Previous to these replacements, the filter media was a dual media system consisting of anthracite and sand with support gravel. The replacement media was tri-media system consisting of anthracite, sand, garnet and support gravel. However, as indicated in the 1986 Master Plan Report when Filters 1 and 2 were dual media and Filter 3 and 4 were tri-media, the filter loading rate for all filters was the same at 3 gpm/sf. It was not until the tube settlers were added in 1990 that the filter loading rate was increased to 4 gpm/sf and the plant capacity increased to 24 mgd.
- Other available technologies that were evaluated in the LRWCP and WSE include: pretreatment (conventional coagulation and sedimentation, inclined plate sedimentation, dissolved air flotation, ballasted clarification, sludge blanket clarifiers); filtration (granular media filtration, membrane filtration); disinfection options (chlorine/chloramine, chlorine dioxide, ozone, UV); taste and odor control (powder activated carbon, granular activated carbon). However, the above technologies evaluated would be more costly to implement than the current recommended plan. Specifically for filtration, the tri-media system currently used by CBU provides the most effective filtration media. Black & Veatch did evaluate the use of membrane filtration for the Monroe WTP; however, the cost to retrofit the existing 24 mgd capacity and to increase the capacity to 30 or 36 mgd would be more costly than the current recommended approach.

Comment
11. Discussion of Maximum Day. The maximum day demands have always been below the rated plant capacity of 24 mgd. The trend in maximum day figures needs to be evaluated in detail. Storage is a component of meeting the maximum day and has not been included in the overall evaluation. Also, how does conservation help?

Response:

- As indicated in the LRWCP and WSE, maximum day demand is utilized in sizing water supply and treatment facilities. The difference between maximum day demand and maximum hour demand is the criteria for planning storage tank and distribution facilities capacities and locations. The trends in maximum day demands have been evaluated in Sections 3 of the LRWCP and WSE as indicated above. Although the demands have been less than 24 mgd, the water demand trends could exceed the Plant capacity in the near future. Therefore, it is prudent for CBU to proceed with the Plant expansion to ensure the Plant capacity is greater than customer demand.
- The use of additional storage is not a solution in meeting maximum day demands for the following reasons:
    - Sustainability – The use of storage without increased capacity will not meet maximum demand conditions over a sustained period. The following graph demonstrates tank levels and operational problems that occur when water demands exceed the treatment capacity based on CBU's current storage facilities capacity, increasing the storage capacity by 2 million gallons, and increasing the storage capacity by 3 million gallons.



- Water Quality – Water quality could suffer if storage is increased. Additional distribution storage under low demand conditions may increase water age, increase in disinfection byproduct (DBP) formation, affect compliance with EPA's Maximum Contaminant Levels (MCL) requirements, and reduce disinfectant residual concentrations in the distribution system.

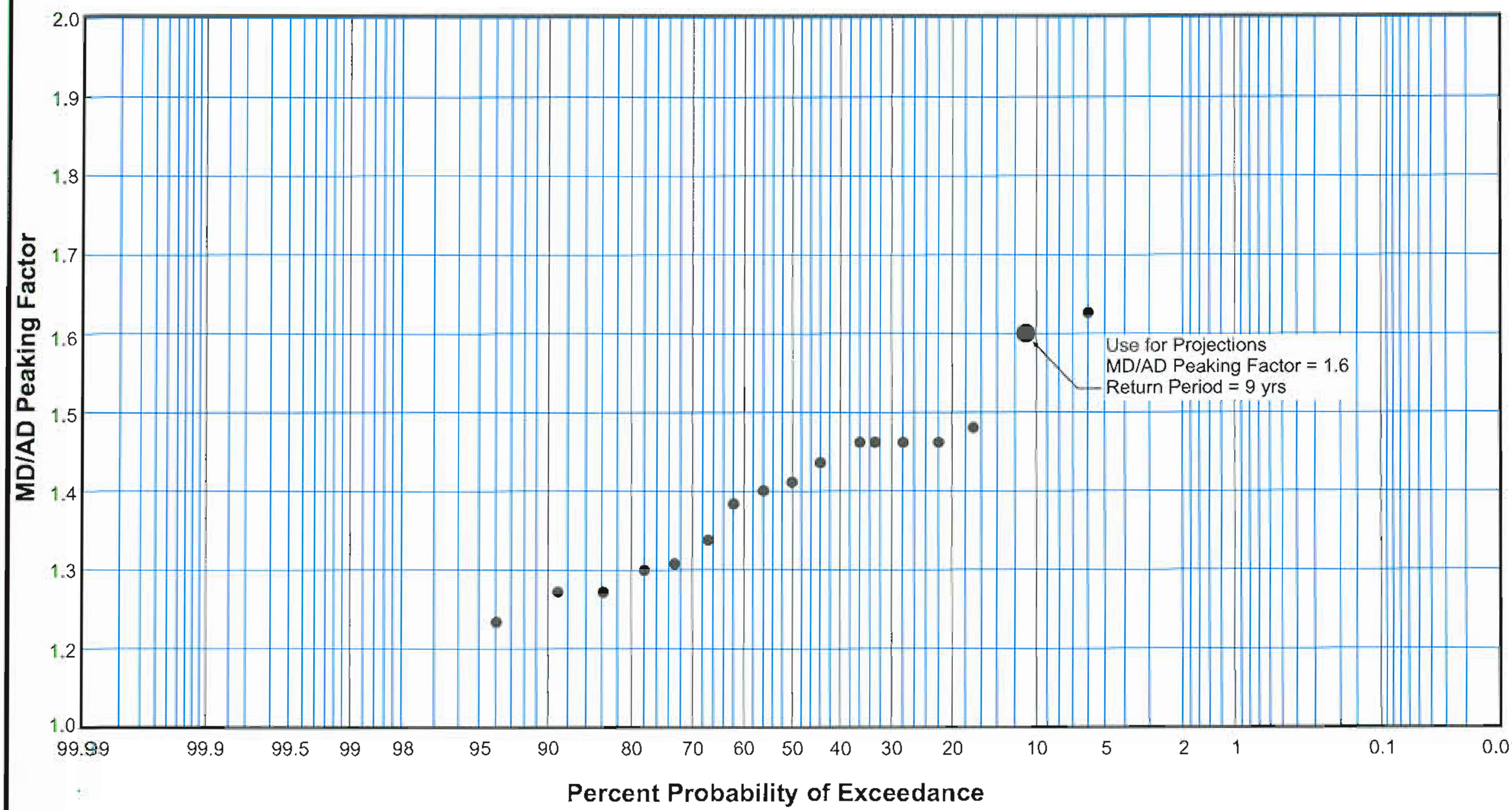
- Conservation measures have been evaluated in Section 3 of the WSE and it is recommended that CBU evaluate potential water conservation programs. Per the American Water Works Association (AWWA) Manual of Water Supply Practices *Water Conservation Programs - A Planning Manual*, "water restrictions can be a useful emergency tool for drought management or service disruptions, [while] water conservation programs emphasize lasting day-to-day improvements in water use efficiency." Long-term conservation programs can be practiced by various entities associated with water use including the end users (residential, industrial and agricultural) and water suppliers (utilities). Table 3-6 from the WSE lists some of the common practices for water conservation by each of these entities.

Table 3-6
Examples of Water Conservation Practices

Residential End User	Industrial End User	Agricultural End User	Water Suppliers (Utilities)
Low-flush toilets	Water reuse and recycling	Irrigation practices to distribute water more effectively	Metering
Toilet displacement devices	Cooling water recirculation	Monitoring soil and water conditions	Leak detection programs
Low-flow showerheads and faucets	Reuse of deionized water	Water reuse and recycling	Water main rehabilitation programs
Faucet aerators	Efficient landscape irrigation practices		Water reuse
Pressure reducing valves on service connection			Retrofit programs
Gray water use			Modifications to existing rate structure
Efficient landscape irrigation (xeriscape)			Public education

- The benefits from conservation and the effect on water demand are difficult to quantify or predict. B&V's experience has indicated that the estimated 85 gallons per capita per day (gpcd) water usage would not substantially decrease and therefore the estimated water demands would not significantly change. The simplest (i.e. most cost effective) conservation measures for residential users in most locations have already been implemented as low fixtures and devices are now standard for all new construction or replacements.

- CBU's rate consultant, Crowe Chizek and Company indicated at the August 27, 2007 USB meeting water suppliers in the western United States which are affected more by severe climate changes and weather patterns have been dealing with water shortages for years and therefore are required to have strict conservation or restriction plans in place. These utilities generally use an increasing rate scale, meaning users that consume more water pay a higher rate. It was said that was the most effective way to actually change people's behavior. However, the City of Bloomington currently does not have this type of rate structure.



City of Bloomington Utilities
Water System Master Plan - 2003

MD/AD Peaking Factor
Frequency Distribution (1985 - 2001)

Figure 3-3

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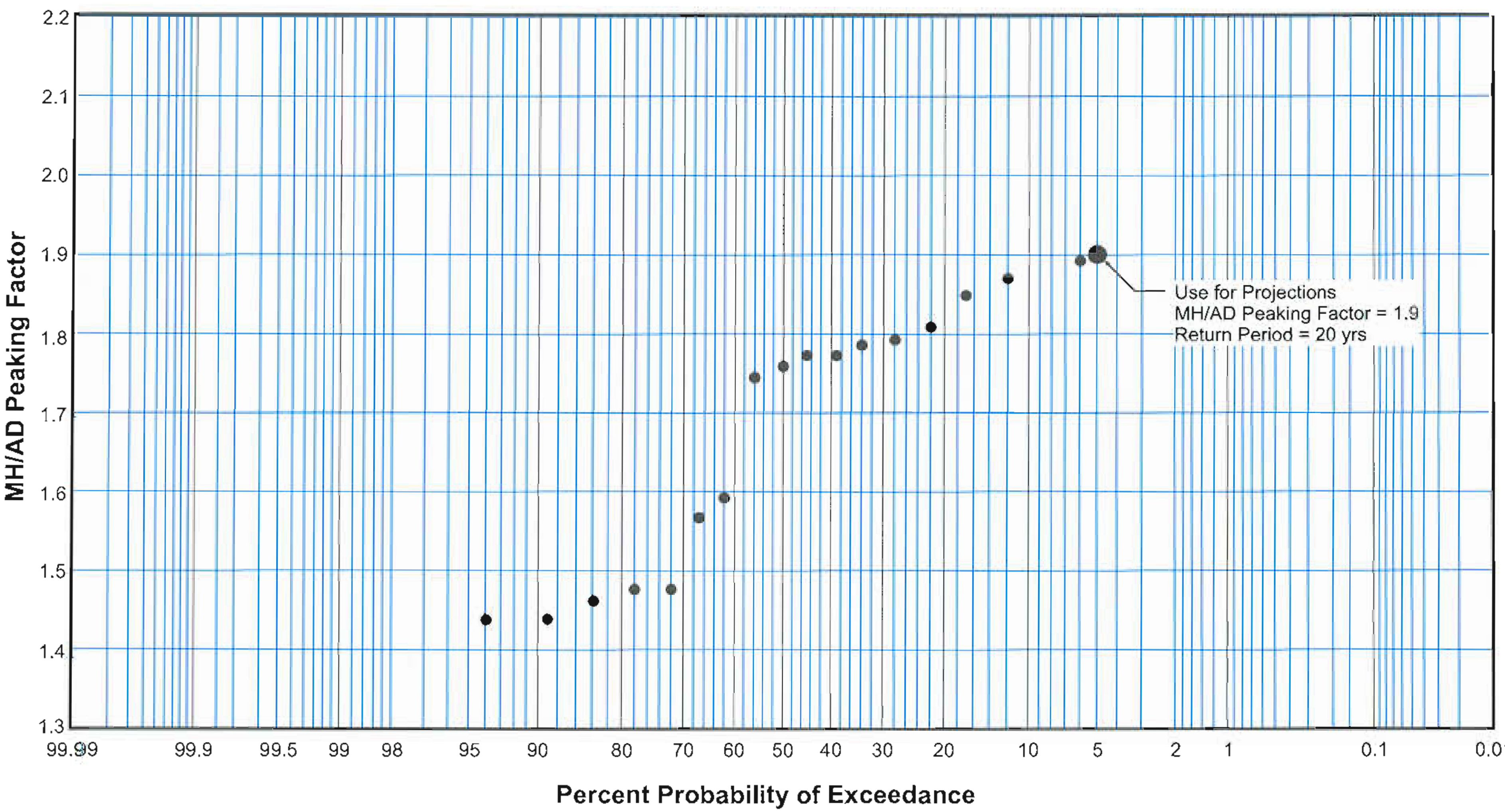

City of Bloomington Utilities
Water System Master Plan - 2003

MH/AD Peaking Factor
Frequency Distribution (1985 - 2001)

Figure 3-4

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